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The role of school-based dental programme on dental caries experience in Yogyakarta Province, Indonesia

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Objectives. To assess the effectiveness of a school-based dental programme (SBDP) in controlling caries by measuring the relationship between the SBDP performance and caries experience in children aged 12 in Yogyakarta Province, Indonesia, by taking into account influencing factors.

Methods. A cross-sectional survey was undertaken of 1906 children participating in SBDPs. Four SBDPs were chosen by good and poor performances in urban and rural areas. Caries was assessed using WHO criteria whereas behaviour and socio-demographic factors were collected using a questionnaire administered to the children.

Results. The decayed, missed, and filled teeth (DMFT) of children in good SBDPs (2.8 ± 2.4) was lower than that of the counterparts (3.8 ± 3.4). From path analysis using a structural equation model (SEM), place of residence (OR = 4.0) was shown to have a strongest direct relationship to caries experience, whereas SBDP performance showed no direct relationship. At the same time, SBDP performance was significantly related to frequencies of dental visits (OR = 0.3), sugar consumption (OR = 0.8), and tooth brushing (OR = 3.2), which in turn are interrelated with place of residence, gender, and mother's education.

Conclusions. The study suggests that the differences in DMFT of children in good and poor performance SBDPs were caused by relation to social factors rather than by relation to oral health service activities.

Introduction

In Indonesia, nationwide school-based dental programmes (SBDP) have provided dental care for children in elementary schools for many years. According to a manual published by the Ministry of Health of the Republic Indonesia, SBDPs are organized by community health centres (CHCs) distributed across Indonesia as part of a national strategy of school health, aimed at promoting health by preventing diseases and establishing good health behaviour. The SBDP activities consist of (i) screening individual children for oral diseases (ii) providing oral health education including demonstration of tooth brushing in

school (iii) training teachers to teach oral health matters, and (iv) providing treatment in the CHC dental clinics following positive findings in the screening.

Given their permanent position within the school health scheme, SBDPs are potentially an ideal setting for achieving good oral health for school children. The role of oral health programmes for school children has been shown to be successful in countries around the world, with various strategies having been implemented. In Nexø, Denmark, a successful strategy was based on non-operative caries treatment emphasizing mechanical plaque control and considering the eruption period of molar teeth¹. In Sweden, supervised brushing with fluoride toothpaste was provided². In schools in Brazil, the onus was placed on educational activities³. It seems here that well-designed oral health programmes can lead to a decrease in children's oral disease.

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An increasing trend of caries experience in 12-year-old Indonesian children, however, has appeared in recent years⁴. Regional differences in caries experience in Indonesia were shown in a national epidemiological survey in 2007⁵. The result of this survey showed that Yogyakarta Province, situated on Java island, had a particularly high caries experience of the total number of decayed, missed, and filled teeth (DMFT = 6.5) compared with the average experience in Java (DMFT = 4.8) and across all Indonesia (DMFT = 4.9). Caries experience is also high compared with Thailand (DMFT = 3.7) and India (DMFT = 3.9), which have comparable characteristics as developing countries⁶. The high caries experience in Yogyakarta Province raises the question of whether SBDPs can control caries in school children.

Yogyakarta Province is the second smallest province in Indonesia and has the highest population density of Java. It has an area of 3185.8 km² with an approximate population of 3.5 million⁷. There are 117 CHCs in Yogyakarta province running compulsory SBDPs⁸. Based on the manual, SBDP could be classified as good performance when the achievement of targets are the following: (i) > 80% of schools in a CHC's catchment area are participating in the programme, (ii) oral health screening followed by oral health education in classrooms occurs at least twice a year, (iii) > 80% schools practise classroom tooth brushing, (iv) > 80% of children with positive findings receive complete treatment upon referral, and (v) teachers are trained in matters of oral health at least once a year. A CHC could be considered as performing SBDP poorly when none of the targets are met as required. The differences in SBDP performance created an opportunity to shed light on the role of SBDPs in controlling caries by comparing caries experience in 12-year-old children in respectively good or poor SBDPs.

It is hoped that by achieving the targets, the caries disease in children will be decreased successfully. Caries experience is also influenced, however, by other factors. For example, the relationship between place of residence and the mothers' education⁹ which in developing countries is more likely

to represent the socioeconomic status (SES) of the children^{10,11}. Strong relationships have also been demonstrated with gender and oral health behaviours such as the pattern of sugar consumption, dental visits, and tooth brushing. It has previously been recognized that the factors associated with the development of dental caries are actually interrelated. For instance, gender is directly related through biological factors to caries experience but indirectly through behaviour; boys show less positive oral health behaviour than girls^{12,13}. In wealthy countries, higher SES is positively related to frequent dental visits and lower caries experience, but in developing countries, SES is positively related to frequent sugar consumption, which leads to a higher caries experience^{14,15}. These findings, however, suggest that in relating organized oral health care such as SBDP to caries experience, the influences of and interrelations with other factors should be taken into account.

Accordingly, this study employs a framework of caries factors developed by Holst *et al.*¹⁶ The framework was demonstrated that caries has complex relationships with many interrelated factors, such as oral health services, socioeconomic condition, biological factors, and oral health behaviour. In analysing the complex relationships of factors, an appropriate method should be chosen wisely. Therefore, a structural equation model (SEM) was the choice of analysis in this study, as it has an ability to examine a chain of factors¹⁷.

The aim of this study was to assess the relationship between SBDP performance and the caries experience in children aged 12 in Yogyakarta Province in Indonesia by considering influencing factors. The outcome of this study could be an indication of the effectiveness of SBDP in controlling caries, which may impact on the policy recommendations for SBDP.

Material and methods

The cross-sectional study was carried out in Yogyakarta Province in 2009–2010. Four CHCs were selected from urban and rural areas, representing both good and poor SBDPs. Information on the performance of

SBDP was derived from unpublished annual report by CHCs in Yogyakarta Province. The CHCs were chosen on the basis of their willingness to be involved in this project evaluation. The subjects in this study were children aged 12 from all public and private schools, in those four CHCs' catchment areas. Parents and children were informed about the study and were made aware of the fact that participants could withdraw from the study at any time.

The survey involved an oral examination and the completion of a questionnaire. In the oral examination, a visual DMFT counting for caries experience status was carried out according to the WHO criteria for epidemiological studies¹⁸. These criteria were chosen as they strongly resemble the criteria used in the system of screening in SBDP and the methodology of oral health surveys in Indonesia. The examination was carried out in the classroom using plane mouth mirrors, standard explorers, and torch lights on batteries which were replaced every 2 days.

Prior to the study, the first author (RA) and three dentists (examiners) were trained and calibrated to ensure the reliability of the examination. The trainer, a senior lecturer in public dental health at Gadjah Mada University Yogyakarta with extensive experience in oral health surveys, served as the benchmark standard. Calibration exercises for weighting the inter-examiner reliability were conducted on children aged 12 not included in the final

survey. Calibration was performed by duplicating the caries examination on a minimum of 20 children by an examiner and the benchmark standard. During the fieldwork, 10% of the subjects in each school included in this study were randomly selected and examined twice in the same day by the examiner for intra-examiner reliability. The inter- and intra-examiner agreement was expressed by Kappa statistics as recommended by the WHO¹⁹.

After clinical examination, all the children taking part in the study were individually assisted by four trained dental nurses to complete a structured questionnaire. The questionnaire was aimed at collecting information for testing the proposed model of causal factors on caries experience represented in Fig. 1. The questions addressed socio-demographic factors (place of residence, gender, and mother's education) and oral health behaviour (pattern of dental visits, frequency of sugary foods or drinks consumption, and pattern of tooth brushing frequency in a day). The level of education of the mother was characterized in terms of the basic level of education in Indonesia²⁰. The questionnaire was pre-tested on a sample of 46 children from a school which was not part of this study to test the unambiguity and ease of understanding. Accordingly, some modifications of the questionnaire were made.

Mean, standard deviation and interquartile range were used to compare the caries

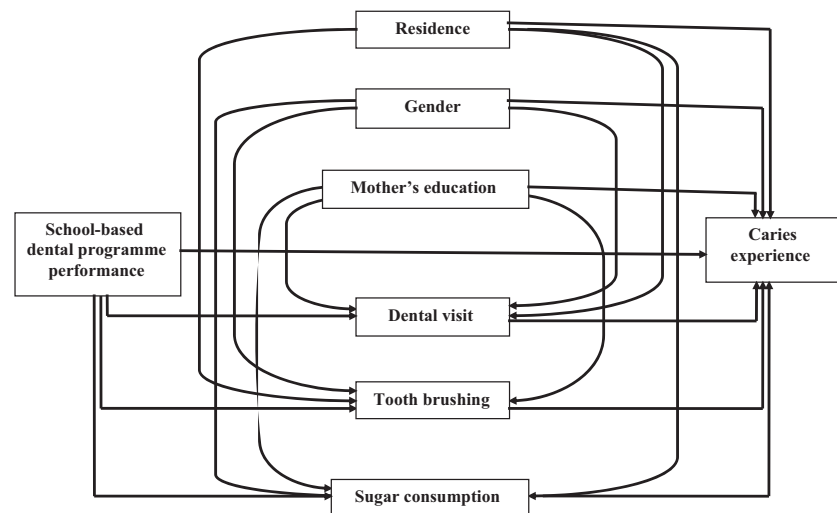


Fig. 1. Hypothesized model of the relationship between caries experience and influencing variables.

experience of the children in good and poor performance SBDPs. These analyses were carried out by means of the SPSS 16.0 (SPSS Inc., Chicago, IL, USA). Binary outcomes from all the variables observed were analysed with path analysis using a structural equation model (SEM). SEM analysis was implemented by Mplus v.6 (Muthen&Muthen, Los Angeles, CA, USA) to examine the odds ratio and confidence interval (95% CI).

Ethical approval was obtained from the Ethical Committee of the Faculty of Dentistry Gadjah Mada University Yogyakarta Indonesia. The names of the children in need of curative treatment were given to the teachers who in turn informed their parents for referral for treatment in the CHC.

Results

Concerning the pre-survey training, inter-examiner agreement was high, shown in a Kappa value range of 0.88–0.91. The intra-examiner agreement over the course of the survey was also high, shown in a Kappa value range of 0.89–0.94. In the final survey, for the children from the 55 schools involved in the study, the response rate was 81.3% ($N = 1906$ children). Of all the children examined, 53.8% were boys and almost half (44.3%) had mothers with ≥ 10 years of education. As for behaviour, 90.2% never/rarely visited a dentist, 91.3% brushed their teeth ≥ 2 times a day, and 59.1% consumed sugar ≥ 5 times or more a day.

The total caries experience (DMFT) among the children is shown in Table 1. The major proportion (92.1%) of DMFT was decayed teeth (D components), whereas missing (MT)

and filled teeth (FT) accounted for 5.4% and 2.4%, respectively. The proportion of children with caries-free dentition (DMFT = 0) was 19.6% ($N = 373$). Table 1 summarizes the occurrence of dental caries among the children examined and relates that to SBDP performance. The mean DMFT in good SBDPs was lower (2.8 ± 2.4) than in poor SBDPs (3.7 ± 3.4). The caries experience was dominated by untreated caries in all SBDPs. The result of the interquartile range (IQR) as dispersion is presented because the distribution of caries experience was skewed. The IQR showed that MT and FT were also skewed. The skewness of the MT and FT variables goes forward into the DMFT variable.

Figure 2 presents relationships between the study variables by pathway analysis. The results showed that SBDP performance had no significant direct relationship with the caries experience of the children but was significantly related to the three behavioural factors. The direct relationship to caries experience was supported by the 'living in an urban area' and 'being a girl' variables. As for behaviour, children cared for by a poor performance SBDP brushed their teeth less frequently and were more likely to visit a dentist for dental care. At the same time, children living in urban areas were significantly more likely to brush their teeth and consume sugar ≥ 5 times a day. Living in urban area had no significant association with the number of dental visits. Children with better educated mothers were more likely to consume sugar ≥ 5 per day and visited dentists significantly more often. As for gender, girls brushed their teeth significantly more often than boys did. Of these three oral health behavioural factors, it was found that only

Table 1. Mean, standard deviation (SD), median, and interquartile range (IQR) of dental caries experience in 12-year-old children in good and poor performances of school-based dental programme (SBDP).

Item	Mean (SD)			Median (IQR)		
	Good	Poor	Total	Good	Poor	Total
DT	2.5 \pm 2.3	3.6 \pm 3.4	3.0 \pm 2.9	2 (4)	3 (4)	2 (3)
MT	0.2 \pm 0.6	0.2 \pm 0.5	0.2 \pm 0.5	0 (0)	0 (0)	0 (0)
FT	0.1 \pm 0.0	0.0 \pm 0.2	0.1 \pm 0.4	0 (0)	0 (0)	0 (0)
DMFT	2.8 \pm 2.4	3.8 \pm 3.4	3.3 \pm 3.0	2 (3)	3 (4)	3 (4)

DT, decayed teeth; MT, missed teeth; FT, filled teeth; DMFT, decayed, missed, and filled teeth.

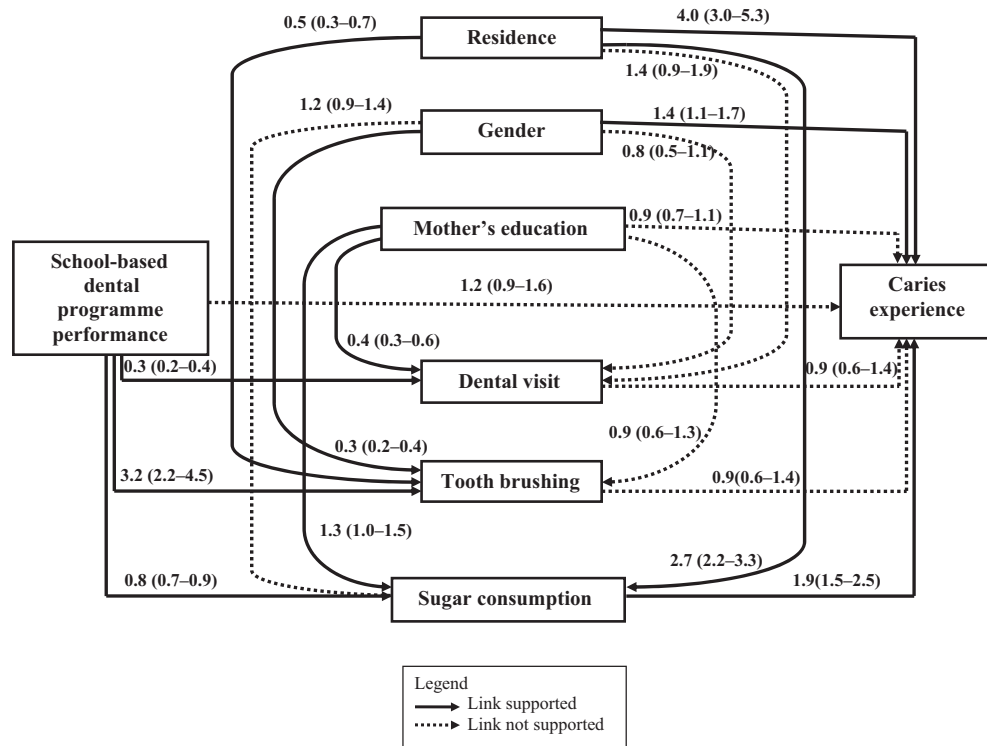


Fig. 2. Path analysis for hypothesized model with odds ratio and 95% confidence interval.

frequent sugar consumption was associated with caries experience.

Discussion

This study has shown that most children had untreated caries lesions, which was by far the largest proportion of caries experience. From descriptive analysis, children participating in good performance SBDPs had lower caries experience than children in poor SBDPs. Furthermore, path analysis by SEM revealed that the performance of SBDP had no significant relationship with caries experience. This pathway analysis explains that the difference of caries experience in SBDPs was most likely caused by the relationship with influencing factors such as residence, mothers' education, and gender, with urban area being the strongest predictor. Evidently, SBDP performance had a significant relationship with the three oral health behaviours; however, at the same time, oral health behaviours were also inter-related with the following socio-demographic factors: place of residence, gender, and mother's education. In this study, from the

three behaviours examined, only sugar consumption was found to cause dental caries.

The most concerning result, however, is that in Yogyakarta Province, the dental caries experience of permanent teeth in 12-year olds is very high compared with the national Indonesian target as defined by its Ministry of Health: DMFT \leq 1 and more than 50% of 12-year-old children caries free in 2010. More disturbing is the overwhelming prevalence of untreated caries. Caries is not under control even in the areas covered by good SBDPs, given the small number of filled teeth (FT) recorded compared with the large number of untreated cavities (DT). The very large proportion of untreated caries is high compared to Malaysia, where the largest portion of caries experience is filled teeth²¹. The very small portion of FT apparently showing that the existence of SBDP has not directly impacted on the treatment for caries in children. This is an unsatisfactory outcome for the SBDPs, as untreated caries could become the source of considerable pain and suffering for many children.

Furthermore, the most important finding was demonstrated by SEM analysis. There

was no direct relationship between programme performance and caries experience. A direct relationship was shown for urban residence, being a girl and frequent consumption of sugar, with the strongest predictor being urban residence. The influence of children's background was also clearly shown in oral health behaviour variables as a mediating factor in caries experience. It seemed that effective performance in SBDPs was related to certain oral health behaviours; but in fact, oral health behaviour was also strongly related to the children's socio-demographic background. In other words, it is possible that good SBDP might be supported by the favourable social environment with better opportunity for children to have good oral health status and behaviour. This finding, however, strengthens the suggestion of previous finding that providing organized public dental care does not necessarily create better dental caries status, as personal backgrounds have a more prominent role in health²².

The results of the analyses, however, have substantiated the role of SBDPs in developing good oral health behaviour in children, which was demonstrated by the favourable relationship between SBDP performance and tooth brushing behaviour. This comes as no surprise because one of the activities promoted by SBDPs is brushing behaviour. Simultaneously, brushing behaviour, however, is also supported by urban location. It appears that the campaign to improve oral behaviour was mostly effective in urban areas, as it was supported there by better information dissemination and access to tooth brushes than in rural areas²³. This study suggests that children from rural areas may face obstacles to receive oral health education and not have equal opportunities to engage in practising good oral health behaviour as a consequence of their disadvantaged socioeconomic environment.

The pathways explained that even though the effectiveness of SBDP was related to sugar consumption behaviour, this relationship was less significant than urban location and mother's education. It is assumed therefore that children living in urban areas with well-educated mothers will have better access to sugar as a result of their socioeconomic

status²⁴. This finding, however, indicates the unfavourable side of modern lifestyles. This group of children, with apparently high sugar consumption, has a concomitant strong relationship to caries experience. Hence, it is important to raise awareness that in developing economies like Indonesia, sugar and sugary snacks are increasingly available as desirable luxury goods for all.

Regarding the results of this study, it is important to reflect on the strategy implemented in the SBDPs in achieving better oral health status for children. First, the strategy in clinical implementation which emphasizes screening and referral may not result in better oral health when the aim is simply to refer and treat the disease without efforts on preventive care. The referral system in SBDPs itself seems fail to increase the utilization of dental services, as shown by the low number for fillings (F) and high numbers of children who never/rarely visited the dentist, which in line with the results of a study in England²⁵. In a developing country like Indonesia, however, dental screening is still considered important in reducing oral health inequalities by bringing children with clinical needs into contact with dental services. Without any follow-up procedure after screening, the expected impact for children to receive the appropriate treatment may not be achieved. This study suggests to comprehensively evaluate the strategy of screening and referral in SBDPs to be significantly effective in reducing untreated caries.

Second, the result of this study suggests that even though the regularity of oral health promotion has potential benefits for children, this intervention is also complicated by the more pervasive socio-demographic patterns that strongly affect behaviour. Gochman²⁶ noted that failure in promotion programmes was driven by attempts that are purely programmatic but lack of knowledge of the social factors that determine and stabilize behaviour. This finding suggests that to achieve effective oral health education in SBDPs, an understanding of the oral health relationship between SES and lifestyle remains critical.

The strengths and weaknesses of this study can have implications for future research. To

our knowledge, this is the first study to test the complex relationships affecting school-based dental programmes and their outcomes. The sampling of the CHCs was based on convenience rather than random sampling, which could cause bias and limit the generalizability of the results. The CHCs chosen, however, represent a relevant and varied section of socioeconomic backgrounds, such as area of residence and mother's education. Some social desirability bias could be present in the answers to the oral health behaviour questionnaire. Over-reporting can be expected regarding desirable outcomes such as the frequency of dental visits and tooth brushing frequency. On the other hand, the consumption of sugar is likely to be under-reported. To minimize this risk, each child was interviewed individually by a dental nurse trained in tracking behaviour, especially sugar consumption behaviour.

It is suggested that the next study be designed with a randomized trial to minimize allocation bias and assure definitive testing. It is also suggested that the model be extended using other SES measurement such as parental income. Other possible influencing factors – such as physical, biological, environmental, behavioural, and lifestyle factors – could also be considered to provide more comprehensive results. Another important suggestion for future studies is to use a multilevel model as the setting of the research is in a school environment.

Based on the results of this study, it is suggested that meeting SBDP targets will not necessarily lead to better caries status or a high rate of filled teeth (FT) compared to not meeting targets. More actions are required to modify the intervention to deal with the complex influencing factors of caries. In the context of behavioural change, the main goals of a school-based dental programme should be achieved by measuring the quality of brushing every day, reducing sugar consumption and increasing awareness of the need for visits to the dentist for both preventive and curative treatment.

In conclusion, the differences between the performance of SBDPs with higher and lower DMFT were more marked in relation to social factors than in relation to dental service activ-

ity. This knowledge could be used as a benchmark to assess and improve the intervention design in SBDPs.

What this study adds

- The mean DMFT in 12-year-old children in selected samples was high: 3.3 ± 3.0 .
- Data modelling using path analysis (structural equation model – SEM) reveals the interrelation between SBDP performance and other factors that influence caries experience.
- SEM analysis shows that school-based dental programmes as organized public dental care have no direct relationship with caries experience in children. The children's social backgrounds play a more significant role in caries status and behaviours.

Why this study is important to paediatric dentists

- Urban area, female gender, and frequent sugar consumption are directly associated with caries experience.
- As urbanization and economic growth are rapid processes in Indonesia, consequently, the consumption of sugar will be augmented. Therefore, dental caries can be expected to increase in coming years.
- Dental professionals and decision-makers in public dental programmes should be aware of these associations and use this knowledge to improve their actions, both preventive and therapeutic.

Conflict of interest

The authors declare no conflict of interest.

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